



Biological Control of Weeds Through Use of Introduced Insects

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Introduction

Noxious weeds pose great threats to Utah's agriculture. Herbicides and cultural control offer effective means of controlling noxious weeds in many situations. But in many other settings, particularly in Utah's vast rangelands, such tactics are often neither practical nor cost-effective. Consequently, serious and growing infestations of noxious weeds exist on many acres of Utah soil for which present prospects of control are not encouraging.

One promising but presently underutilized approach to controlling weeds in Utah is biological control, a tactic in which natural enemies (insects, nematodes, and diseases) are relied upon to help reduce densities of weeds. The goal of biological control is not to eradicate widespread weeds (this is simply not realistic), but rather to reduce weed numbers to tolerable levels. Biological control is most likely to succeed when combined with other control approaches in a coordinated or integrated pest management (IPM) approach.

Ecological foundations

Biological control of weeds has been practiced for many years throughout the world. Plant-feeding insects have served most frequently as biocontrol agents, but efforts are increasing to use other organisms as well. In many instances, our weeds originate from overseas. They were brought to North America either inadvertently (for example, in ship ballast) or intentionally (for flower gardens, for instance).

In their geographic place of origin, weeds are often subject to heavy attack from insects and other organisms. Typically, these natural enemies remain behind when weeds invade new regions overseas. In the absence of natural enemies, the weeds become particularly troublesome by vigorously colonizing disturbed (e.g., over-grazed) habitats or even well-established native vegetation (weakened in the competitive struggle by attack from host-specific natural enemies). The balance of competition is often skewed strongly to the introduced weed, allowing it to predominate and crowd out desired vegetation. Most biological control efforts are, in essence, attempts to alter this "balance of power" by introducing the weed's natural enemies from its native land and thereby placing the invader

under greater stress.

In some biological programs, spectacular results have followed upon introduction of biological control agents. The story of prickly pear in Australia is one such example. This cactus was introduced deliberately to gardens in 1839, but quickly found much of the rest of Australia to its liking as well. By 1926, some 60 million acres were infested with stands often so thick that a person could not walk through them. A moth from Argentina was introduced to feed on the prickly pear. Larvae of the moth avidly burrowed into the cactus pads, thereby enabling crippling bacterial and fungal infections to develop. Within a few years, prickly pears had died in huge numbers, and vast areas of Australian rangeland had been reclaimed.

While biological control programs are unfortunately not often so immediately effective, introduced natural enemies do generally act to undermine the weed's competitive ability and resistance to other stresses such as disease and drought. In this way, the ability of native vegetation is enhanced to counter the weed and drive down its numbers.

How Biological Control Programs Are Created

Biological control programs cannot be initiated in cavalier fashion. Of very real concern, of course, is that natural enemies introduced to attack a weed do not become pests themselves! To minimize such risk, federal and state laws and guidelines have been enacted to regulate efforts, and only qualified specialists conduct the research programs to bring new biocontrol organisms into the country. A new program in biological control for a weed must be thought out carefully; often 10-20 years of intensive work may be involved before successful broadscale reductions in weed density can be expected. There are eight basic steps in the multiyear effort to introduce a new biocontrol insect:

- (1) The weed problem must be assessed and reviewed (for example, ranchers and bee keepers may disagree on whether a weed is noxious or desirable).
- (2) A program of foreign exploration and study of insects (and other natural enemies) attacking the weed in its native land must be pursued.
- (3) Extensive tests of host specificity must be made to ensure that, if introduced, an insect will limit its feeding to the target weed (fortunately, many insect species are very narrow in their feeding habits and are therefore suitable for use as biocontrol agents).
- (4) If the insect proves sufficiently restricted in its diet, a formal federal review is conducted to determine whether permission should be granted to introduce the insect to the United States.
- (5) If such permission is granted, the insect is first placed in quarantine and reared for several generations. [This ensures that only this insect is introduced, and not others. Of particular concern are the insect's own natural enemies, including parasites and insect pathogens, which if introduced might undermine the effectiveness of the biocontrol agent.]
- (6) After the insect has been "cleared" in quarantine, initial field releases are made at carefully selected field sites--these sites serve as outdoor or field "insectaries" where the biocontrol agents can multiply.

(7) Once the biocontrol insects are well-established at field insectaries, they may be collected and distributed widely throughout regions infested by the weed (the insects may not be moved into new states, however, without first receiving permission from the appropriate state official).

(8) Finally, as the biocontrol insect becomes widely established, field studies should be performed to evaluate for success in weed reduction.

Utah's Participation In Biological Control Programs

Utah has not had the resources to initiate its own new programs of biological control against targeted weeds. Fortunately, our neighbors (e.g., Oregon and Montana) and the federal government (United States Department of Agriculture- Agricultural Research Service [USDA-ARS] and Animal Plant and Health Inspection Service [USDA-APHIS]) have engaged in vigorous efforts to initiate biocontrol programs and often can provide us with biocontrol insects now well- established elsewhere in western North America. In addition, field insectaries are now being created in Utah for new biocontrol agents (recently approved for general release in the United States, but presently available in only small numbers) for several weeds (squarrose knapweed, leafy spurge, and purple loosestrife); in coming years, these sites should serve as in-state collection sites for these biocontrol agents.

Among the noxious weeds that occur in Utah, biocontrol insects are presently available primarily for knapweeds, thistles, and leafy spurge. The USDA-APHIS is currently disseminating biological control insects against knapweed (diffuse and spotted) and leafy spurge [the agency generally makes insect releases in weed infestations of at least five acres on land that will be protected from pesticides for at least five years]. In addition, private companies are now in business (e.g., in Montana and California) to collect and ship biocontrol agents against noxious weeds.

Private landowners, as well as county weed supervisors and other personnel, may wish to purchase biological control agents for release. In planning releases of biocontrol agents in Utah, however, remember that you are required receive permission prior to such releases from the State Entomologist at the State of Utah Department of Agriculture (Salt Lake City).

Further Reading

DeBach, P. 1974. Biological control by natural enemies. Cambridge University Press, New York. Harris, P. 1988. Environmental impact of weed-control insects. BioScience Vol. 38, pp. 542-548 Strobel, G. A. 1991. Biological control of weeds. Scientific American (July 1991), pp. 72-78

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